Passed out @ Nov PCT mtg, review

Water Transfers in Context of the CALFED Bay-Delta Program

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At the BDAC Water Transfer Work Group meetings, as well as during other CALFED public discussions, questions have been raised regarding both the physical capacity to transfer water given either existing conditions or CALFED alternatives, and the potential quantity, sources, and destination of transfers. At this stage of analysis of the CALFED alternatives, it is not possible to provide complete answers to these questions. It is possible, however, to provide a general response that may be helpful in providing some context for the discussion of water transfer policy issues, such as third party impacts and groundwater use and protection. The intent of this memo is to:

- Describe the estimated available transfer capacity of the existing system, both physical and constrained by legal and regulatory requirements
- Discuss the potential effects CALFED alternatives may have on available transfer capacity and how this capacity may be estimated using physical models
- Speculate on the demand potential for south-of-Delta water transfers
- Discuss the potential demand for water transfers to meet environmental needs
- Portray the additive or inclusive qualities of the various water transfer demands
- Discuss the use of economic modeling for transfer policy analysis

The information presented below is very general and based on several data sources as well as professional judgment. The information is not exact, but it should help focus the work group effort on resolution of water transfer policy issues that exist regardless of future water transfer quantities or limitations.

Available Transfer Capacity of the Existing System

The existing storage and conveyance system is *physically* limited by the size of channels, pumping plants, and storage reservoirs at various points in the system. For instance, if supply and demand existed and if the State Water Project and Central Valley Project south Delta pumping facilities were to pump at full capacity 365 days a year, the total export could theoretically be as much as 11 million acre-feet per year. Of course this has never occurred, nor is it anticipated to occur because of demand and supply limits, operational logistics, and regulatory and legal constraints. For example, routine maintenance of the facilities requires temporary shutdown which reduces the total days of potential operation. Historically the combined exports of these facilities is generally 6 to 7 million acre-feet annually, except during dry and critically dry conditions when it is less.

Given the existing level and annual patterns of SWP and CVP water demands, there are periods when "unused" *physical* capacity remains in the system. For instance, if export demands south of the Delta only use 50 percent of the system's existing capacity to export water during a particular month, then "unused" *physical* capacity exists. However, if the existing Project demands use 100 percent of the system's capacity at a particular time, no "unused" capacity exists.

However, this "unused" *physical* capacity is even further limited by regulatory constraints that govern the operation of the various system features. These include, but are not limited to:

- Delta outflow and water quality requirements and export constraints contained in water rights permits and the Endangered Species Act biological opinions (existing and future)
- the 1994 Delta accord and agreements to operate the CVP and SWP to meet the objectives of the State's 1995 Bay-Delta Water Quality Control Plan
- permit limitations on south Delta pumping (Corps of Engineers)
- the Coordinated Operating Agreement between DWR and the Bureau of Reclamation
- flood control criteria for reservoirs and surface waterways (an operational constraint)

Such regulatory constraints can greatly reduce the "unused" capacity. In some instances, even though physical capacity exists, "unused" capacity due to regulatory constraints may be zero, meaning no additional water can be exported. However, regulatory constraints are not absolute limits on the ability to transport water, especially across the Delta. If a transfer agreement provides sufficient additional water supply to satisfy water quality or outflow requirements (e.g., carriage water), then it may still be transferable (as long as physical capacity exists). Though, in instances where Endangered Species Act biological opinions result in stoppage of pumping, even "unused" capacity will not be available regardless of attempts to provide sufficient additional carriage or transport water.

The results of computerized modeling that assumes use of existing facilities, existing regulatory constraints, and historic hydrologic conditions, allow us to estimate the potential "unused" capacity. As shown in Figure 1, while "unused" *physical* capacity can be as great as 6 million acre-feet during critically dry periods, *regulatory and operational* constraints limit the available capacity in most cases to slightly under 1 million acre-feet. These values, however, are the result of models which assume every acre-foot difference between what is actually pumped and what is theoretically available is "unused". Actual project operations sometimes conservatively assume the facilities are operating at maximum capacity, even when they may not be. For instance, if 6400 cubic feet per second (cfs) of capacity exists but the projects are operating at 6300 cfs, operators assume that there is no additional capacity. The model, however, would count the 100 cfs difference as available for transfers. It would be appropriate to assume that conservative operations of the facilities further reduce the real capacity below the 1 million acre-feet estimated by the models. A more realistic estimate may be that "unused" *regulatory* capacity, or "available" capacity, is between 0.5 and 1 million acre-feet. It should also be noted that this capacity will be directly affected by increases of SWP entitlement deliveries. As project deliveries go up, available capacity for transfers will correspondingly decrease. As shown on Figure 1, the available capacity in wetter years (above normal) is slightly less than dry years since state and federal project water is more abundant and available for delivery. (For clarity, note that "unused" capacity generally relates to physical constraints while the term "available" capacity refers to conditions constrained by regulations and operations.)

Another physical constraint of the system is the limited additional pumping capacity at the Edmonston pumping plant located at the southern end of the San Joaquin Valley on the California Aqueduct. This facility delivers water to southern California and is estimated to currently have between 0.8 and 1.9 million acre-feet of "unused" capacity annually. This is greater than the regulatory capacity at the south Delta pumping facilities, but it could limit the ability of southern California water suppliers to deliver transfers under existing conditions if Delta export constraints were reduced.

Timing and Demand. The ability to use "available" capacity is dependent on many factors, especially the:

- time the capacity is available (which is dependent on existing physical and institutional constraints)
- demand for transferred water at those times or ability to store surplus water south of the Delta
- willingness to transfer during periods that require significant carriage water requirements (i.e., when regulatory constraints only allow 35 percent of Delta inflow to be exported)
- availability of transferrable water at those times
- economic considerations such as additional pumping cost (on- versus off-peak) and mitigation measures

For instance, though 1 million acre-feet of capacity may exist, much of it may only be available during late fall or early spring, times that may not correspond to any need. If corresponding demand does not exist, or if south of Delta storage is not available, or if transferable water is not present, then the available capacity would not be used. Recently, some of the available capacity in the California Aqueduct (the State's system) has been used to transport water for the federal contractors. It has also been used to a lesser extent to provide "interruptible" supplies to existing State Water Project contractors (interruptible supplies are deliveries of surplus SWP water to contractors above contractual supplies). These deliveries reduce the capacity for non-project related water transfers.

Figure 1 shows the rough distinction between transfer capacity from October through March compared to that from April through September. Depending on the hydrologic conditions of the particular water year, the transfer capacity in particular months can be a significant constraint on the ability to transfer. To date, most short-term transfers have taken place from mid- to late summer through early fall.

Realistically, what may further constrain actual transfers is the inflow-export ratio limitation placed on Delta exports by the May 1995 Water Quality Control Plan. The inflow-export ratio constrains exports from the Delta to only 35 percent of Delta inflows during February through June. From July through January, up to 65 percent of the Delta inflow can be exported. What is significant about this ratio, when it is controlling, is that potential buyers will hesitate to attempt a transfer when they can only export 35 percent of what they purchase. For example, if a buyer wants to export 10,000 acre-feet during April and the inflow-export ratio is controlling Delta export operations, the buyer would have to purchase nearly 30,000 acre-feet. Since 65 percent of the water would be required to flow out the Delta, the actual cost of the 10,000 acre-feet to the buyer would be much greater than the per acre-foot cost paid to the seller ($50 per acre-foot paid for 30,000 acre-feet translates to $150 per acre-foot for the 10,000 acre-feet actually received in the

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buying region, not including transport or other charges). This added cost would significantly limit the desirability of transfers during such periods, a key reason for its existence, even though capacity to transport the water, and demand for it, may exist. (One purpose of the inflow/export ratio is to focus transfers to periods of time when there would be less impact to fisheries and discourage transfers during critical fishery periods.)

When the inflow-export ration is not controlling, other State water quality requirements, such as X2, as well as other regulatory constraints are controlling. Water may be easier to transfer when these other conditions are controlling when compared to constraints of the inflow-export ratio.

Another example of the effect of timing on transfers could be a transfer agreement that makes water available through re-operation of an existing reservoir. Re-operation could make the water available only at particular times, depending on the re-operation criteria (e.g., flood pool, power generation, downstream release requirements). If the out-of-basin transferee (buyer) is unable to take delivery of the water at the time it is made available, a transfer will not occur, regardless of available transport capacity. The same could occur with land fallowing programs if the ability to re-regulate the release of water that previously was delivered on a historical agricultural use pattern to a different delivery pattern is constrained by the local operating criteria of the source reservoir.

Also of primary concern to potential transferring parties is reliable access to facilities for long-term transfers. For a long-term transfer to function, the ability to move the water (wheeling) in every year it is needed is crucial. This certainty, however, does not exist under the current system and operating constraints. For instance, if the transfer is scheduled to occur every year in August, but during a particular year, capacity does not exist in August, the transferred water will be "lost". Lack of certain access to facilities has limited the use of long-term transfers. To date, there have been no long-term cross-Delta transfers successfully negotiated, partly as a result of lack of access certainty (no ability to wheel water). Many short term transfers, though, have been successfully completed during the past decade.

Impact of the CALFED Alternatives on Available Transfer Capacity

CALFED has several alternative configurations that include new storage and conveyance options. The effect of these on the ability to physically move water associated with water transfers is still being analyzed at this point in the CALFED process. However, determination of potential water transfer capacity for each CALFED alternative will be included as part of the Programmatic EIR/EIS.

In general, additional storage and conveyance facilities under consideration in the CALFED alternatives could improve opportunities for water transfers by:

- allowing transfer water to be held in new storage facilities until 1) the buying party can accept the water, 2) conveyance capacity exists to transport the water to the buyer, and/or 3) the water may be transported through or around the Delta with reduced restriction;

- allowing transfer water to be moved through or around the Delta during unconstrained periods of time and held in storage south of the Delta until 1) the buying party may accept the water and/or 2) conveyance capacity exists to transport the water;
- retaining water currently spilled by existing reservoirs (surplus to other needs and uses) in new storage facilities, thereby creating additional supplies potentially available for transfer;
- reducing the impacts that water transfers have on the Delta, thereby expanding the periods of time when transfers can occur;
- creating opportunities to move water between new sources and destinations.

Changes to existing regulatory constraints could also result in a variety of effects on the capacity for water transfers, especially changes that result from new species listings under the state and federal Endangered Species Acts. In some instances, the current regulatory constraints create a transfer need by CVP and SWP contractors when their contractual deliveries are reduced. Species recovery could result in a change to the constraints which could reduce the demand for transfers since contractual deliveries could increase. Water transfer opportunities in various areas of the state (not just across the Delta) could ultimately be increased or decreased as a result of changes in:

- regulatory constraints on Delta exports (changes or additions to ESA biological opinions or the Water Quality Control Plan), especially through the listing of new species;
- policies affecting priority of use of storage and conveyance facilities ;
- permitted south Delta pumping capacity (Corps of Engineers operating permit, State Water Resources Control Board water rights permits).
- improved tracking of water for environmental transfers

Use of Models in Determining Transfer Capacity. System operations modeling, linked with detailed Delta simulation modeling, is being used to evaluate the potential water supply impacts and benefits of proposed physical facilities and operational changes associated with Bay-Delta Program alternatives. Through this process, the available physical capacity of primary storage and conveyance facilities -- potentially available to facilitate transfers -- may be evaluated under the assumptions associated with each Program alternative. Through subsequent analysis of model results, the quantity of transfer water that might be moved through the Delta at various times can be estimated, depending on available physical capacities and the regulatory constraints limiting conveyance of water between any two points.

This modeling approach will not provide information on potential local impacts of any specific water transfer. It will also not provide information regarding the "safe yield" for any particular source area. Before implementing any specific transfer, more detailed investigation would be required to evaluate potential groundwater-surface water interaction and potential impacts on third-party water users and the environment.

Modeling Assumptions. A variety of assumptions are required to complete system operations studies. Capacities of existing physical system components such as primary reservoirs, stream channels, and canals, are generally fixed within the simulation model. Proposed facilities may also be represented to evaluate potential benefits and impacts. Regulatory requirement assumptions are also needed but may be varied between model simulations to evaluate cause and effect relationships. These institutional assumptions define: 1) upstream hydrology and water use (depletions); 2) reservoir operations for water storage, flood control, power production, recreational uses, and temperature control; 3) instream flow requirements for fisheries, navigation, and water quality objectives; 4) Delta standards related to instream flow requirements, water quality objectives, X2 requirements, and export limits; and 5) demand patterns for water.

For CALFED modeling studies, physical system components included for simulation range from including only the existing facilities to including 6.7 million acre-feet of new storage along with various Delta conveyance modifications. The institutional assumptions used in the studies generally include existing levels of environmental protection, such as requirements under the SWRCB Bay-Delta Water Quality Control Plan, Endangered Species Act biological opinions, and Central Valley Project Improvement Act. A 73-year historical period (1922 to 1994) is used to provide hydrological input. Levels of demand for water in upstream areas and Delta export service areas are set to simulate both existing conditions and projected 2020-level conditions, as used for all CALFED impact analyses.

Speculative Demand Potential for South of Delta Water Transfers

California already has an active water transfers market. Every year, hundreds of thousands of acre-feet are transferred or exchanged between willing parties. Most of these transfers consist of in-basin exchanges or sale of water among CVP or SWP contractors. In most cases, these exchanges are not under the jurisdiction of the State Water Resources Control Board because there is no change in place or purpose of use (i.e., the water is still used within the CVP or SWP service area). They are also not widely disclosed to the rest of the water supply community because they occur within existing project service areas.

Most of the demand for water transfers south of the Delta in the foreseeable future would probably be for urban demands in the Metropolitan Water District of Southern California service area and agricultural demands in the federal San Luis Unit. Other SWP export users, such as Kern County Water Agency, may occasionally import water via transfers for conjunctive use and water banking programs. The amount of water any of these entities may be in the market for, however, is only speculative.

MWD's recent Integrated Resource Plan (March 1996) discusses the potential for transferring up to 400,000 acre-feet of water from the Central Valley. According to the Plan, this amount is only needed once every 4 years (25% of the time). Westlands Water District, as well as other federal San Luis Unit contractors, may be looking to transfer up to 300,000 acre-feet in critically dry years. Because of recent regulatory constraints that have limited full delivery of contracted amounts, this quantity may be desired much more than 25 percent of the time; probably more like 50 percent of the time. DWR's Supplemental Water Purchase Program is also looking for 200,000 acre-feet to help meet SWP contract demands during times of shortage. This may be the same need that is targeted by MWD and other SWP contractors.

Bay Area urban water suppliers could also be buyers in a future water market. The extent to which they may participate in water transfers to augment existing supplies is unknown. However, during the last drought event, several Bay Area suppliers, including the City of San Francisco, Contra Costa Water District and Santa Clara Valley Water District and others, were allocated nearly 100,000 acre-feet from DWR's Drought Water Bank. These quantities may increase as urban population increases and existing supplies become insufficient.

The speculative values discussed above represent independent consumptive use demands and are generally additive. However, since these speculative demands are not needed every year, providing an average annual sum total can be misleading. More discussion of the additive or inclusive nature of these demands is included later in this document.

Sources of Transfer Water. Water to be transferred can come from several sources. If properly managed, three of these sources could yield new water without impacting existing beneficial users. The remaining source requires reallocation from existing uses. Potential sources include:

- reservoir re-operation (yielding new water supplies with no impact to existing users provided that all instream flow standards are adequate and are met);
- conjunctive use/groundwater banking (yielding new water supplies with no impact to existing users, provided that the program includes a management and recharge program to ensure no adverse impact to local groundwater resources);
- conservation (recovery of water otherwise lost to beneficial uses with no impact to existing users);
- crop shifting/land fallowing (reallocation from use to another).

The first two sources incorporate changes in the management and operation of existing facilities and aquifers to increase the available yield in the system.

Speculative Demand Potential for Water Transfers to Meet Environmental Needs

Transfers for environmental purposes have also been a regular feature of existing water management for the past 10 years. These have included transfers of water to provide refuge water supplies as well as pulse flows released down the San Joaquin River. In addition to urban and agricultural demand for water transfers, there are also several programs which propose to acquire water through transfers for environmental purposes. Water would primarily be used for instream flow and Delta outflow but could also meet riparian and wetland habitat and wildlife refuge needs. However, ensuring that water actually goes to the intended use will require that it be tracked through the system and properly accounted for in the Delta. For example, water intended to be used exclusively for increased Delta outflow would be subtracted from the actual Delta tributary inflow and outflow calculations. This would administratively remove these flows from availability for export and would allow Delta outflows above the existing standards.

CALFED's Ecosystem Restoration Program Plan (ERPP) and the CVPIA Anadromous Fish Restoration Program (AFRP) will require water to supplement existing instream flows. Current estimates are that implementation of the ERPP targets would require about 400,000 acre-feet and the AFRP, about 600,000 acre-feet. These programs have been developed independently but they target many of the same rivers and tributaries with 80 to 90 percent of the AFRP flows overlapping with ERPP targets, according to CALFED staff. The CVPIA also contains provisions to dedicate 800,000 acre-feet of CVP yield to environmental purposes, as well as another 140,000 acre-feet to meet the incremental Level 4 refuge water supply needs (part of the Central Valley Habitat Joint Venture Plan). Some of the 800,000 acre-feet of dedicated yield may also overlap with AFRP and ERPP flow needs. Specifically, the Bay-Delta Accord provides that any CVP water used to meet the state's water quality control plan or Endangered Species Act requirements is credited against the 800,000 acre-feet. The balance may be used for AFRP or other instream purposes. More discussion about the additive or inclusive nature of these demands is included later in this document.

Sources of Water for Environmental Transfers. Generally, the sources for potential transfer water are the same as indicated previously under south Delta transfer sources.

A promising source could be water conservation actions. It is possible that reducing irrigation losses that return directly back to surface streams and rivers can generate environmental benefits, as long as no adverse impact occurs to existing downstream beneficial users of the return flow. For example, if 20 percent of diverted water that currently returns as surface runoff is not diverted (as a result of efficiency improvements), a quantity of water now available to the previously by-passed stream reach is generated. In addition, the savings could be released from upstream reservoirs on a schedule that benefits fisheries rather than the existing irrigation demand schedule, again as long as existing beneficial users of the return flow are not adversely impacted. To the extent that such actions benefit environmental health without the need to acquire additional water, these flows could be credited toward ERPP and AFRP flow targets.

Additive or Inclusive Nature of Potential Water Transfer Demands

The potential water transfers quantities discussed above are not strictly additive. However, they are not completely inclusive either. Several factors have to be considered when evaluating the additive or inclusive nature of the demands. Examples include:

- Is the transferred water intended to meet the same demand? DWR's proposed Supplemental Water Purchase Program would augment contract supplies during critical water supply periods. A large portion of supplemental water would be supplied to MWD or other SWP contractors in need of drought-year water supplies. It is likely that this would reduce the demand that these agencies would have for transferring water to meet the same drought period need. Therefore, the SWPP demands cannot be directly added to other SWP shortage condition transfer demands such as MWD's anticipated 400,000 acre-feet.

- Is water dedicated for instream flow purposes also required for Delta outflow? If not, depending on the timing, available capacity, and demand, this water could be rediverted once downstream of its areas of need and be transferred to another beneficial user. For example, instream flows on the Yuba River may only be necessary on the Yuba River to its mouth. Once joining the Feather, the water may be available for transfer to another beneficial use. To the extent that recapture of environmental flows can occur, transfer demands for other beneficial uses should not be additive. If flows are dedicated to Delta outflow, one water transfer may serve multiple environmental purposes as it flows downstream to the Bay. In such cases, a unit of water dedicated to AFRP or ERPP flows may help meet several flow targets and yield several benefits, reducing total demands. In other words, one unit of water obtained for AFRP or ERPP targets above existing instream flow standards upstream could also provide water above the Delta water quality and Delta outflow objectives. Alternatively, the water could be accounted for in a way that allows added instream flows upstream and increased exports in the Delta with no increase in Delta outflow.

- Are the AFRP and ERPP targets for tributaries complementary? CALFED Program staff believe that perhaps as much as 80 to 90 percent of the AFRP flows will also function to meet ERPP flow targets. Therefore, ERPP and AFRP flows should not be viewed as mutually exclusive.

- The maximum quantities of transferred water will not be sought annually. In most cases, transfers of water to offset supply shortages will not occur every year, but on a less frequent basis. Smaller quantities may be transferred yearly for direct use or other purposes such as groundwater recharge, groundwater banking, or reservoir refill. Because of the unique hydrologic conditions in the state that result in low precipitation and snowfall in some areas of the state, and greater quantities in other areas, severe shortages will not always occur at the same time throughout the state.

Based on these examples, it is clear that potential demands for agricultural, urban, or environmental transfers should not be directly added. Doing so can inaccurately indicate greater demand for transfers than may actually ever be realized. This is not to imply, however, that all speculative demands are inclusive. Demand for water transfers will likely be great enough that a clear process will be needed to avoid or mitigate third party impacts, groundwater impacts, and environmental impacts where current processes may not adequately do so.

Use of the Economic Models for Transfer Policy Analysis

DWR has developed the Economic Risk Model and has used it as a tool for urban water management planning feasibility studies and EIR/EIS documentation since 1985. The model is demand driven, attempting to solve the unmet demands of a hypothetical need through various supply options based on economics of supply and demand. This model may also be useful to help understand the effect of water transfers on water supply reliability, a CALFED objective, and to help understand the impact of policy-level recommendations to mitigate or avoid third party impacts, though it has not specifically been used for such purposes to date. Specifically, the ERM can be set up to perform the following types of sensitivity analyses:

- changes in regional urban benefits of CALFED storage and conveyance options with respect to changes in the cost and availability of transfers
- change in regional urban benefits of CALFED storage and conveyance options and the quantity of water transferred with respect to changes in third party and environmental impact mitigation policies, including transfer assessments (water surcharges or monetary

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payments) and restrictions on frequency and cumulative quantities of transfers by a particular region
- change in demand for transfers and quantities transferred with respect to the CALFED storage and conveyance alternative selected

The ERM uses the concept of least-cost planning to identify the economically optimal mix of statewide and local urban water management options and exposure to the risk of shortage. Attachment 1 provides more detail of the ERM and its methodology.

One important function of the ERM is the ability to estimate the potential for unrestricted transfers that might occur in the absence of limitations to protect from third-party economic impacts. The ERM can estimate the percentage of a region's demand for additional supplies that might be derived through transfers based on the presence or absence of policies designed to provide third party and environmental protection to source water areas. For instance, a south-state water supplier may desire 0.5 million acre-feet of additional supplies during a severe supply shortage. This water could be derived from a number of different contingency options including water conservation, water recycling, local groundwater use, and import of outside sources through water transfers. Given no policy framework for protecting local interests and resources of potential source areas, the majority of the 0.5 million acre-feet demand could be obtained through transfers, since they may be the most cost-effective source. If, however, a policy framework is in place that constrains transfers to avoid or mitigate third party impacts, the percentage of demand met by transfers should be less. The ERM could be use to help the BDAC work group understand the implications of possible policy recommendations by providing generalized results of the level of transfers given different types of transfer constraints. The resulting amount of demand met by transfers would be an indication of the effect of a particular policy.

In addition to the ERM, another economic model is available (the Central Valley Agricultural Production and Transfer Model) to estimate how much water may be made available through activities such as modified cropping and land fallowing. This model is based on agricultural production economics for Central Valley agriculture. It accounts for factors such as water supply, production costs, crop types and acreage, crop value, and price elasticity which is dependent on supply and demand for particular crop types. The results of this model can show the quantities of water made available from particular regions and the associated crop changes that would take place to make water available. This model was used during impact analysis for the CVPIA Programmatic EIR/EIS.

Focus on Resolution of Water Transfer Issues

Key points of this memo are:

- transfer capacity exists now, but it is not particularly reliable and may not be available for non-CVP/SWP purposes;
- new conveyance and storage, if included in a CALFED solution, would increase the capacity and the reliability for transferring water.

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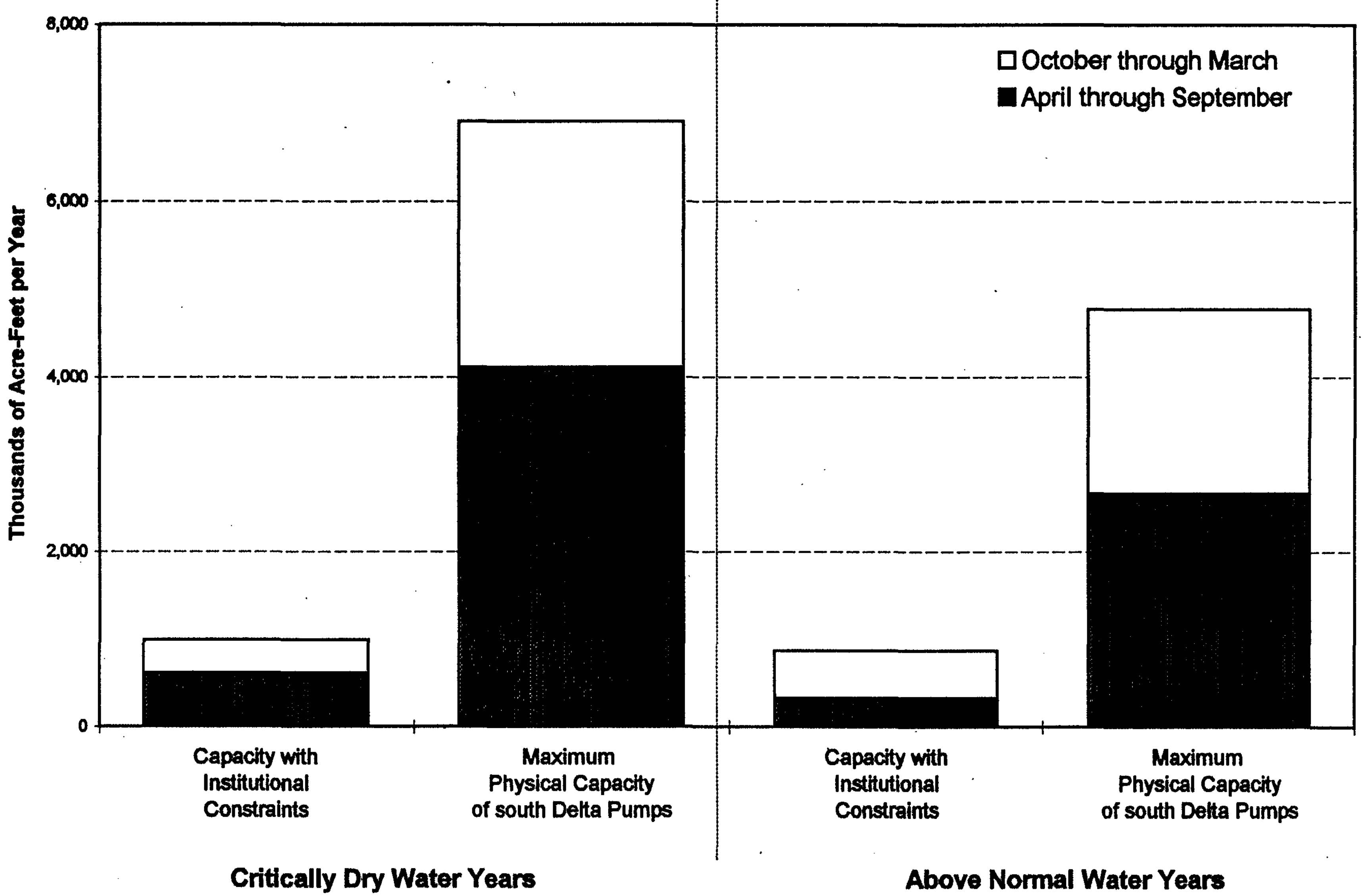
The existence of this capacity and the transfer potential it entails raises several issues which were first identified in the draft Water Transfers Discussion Paper (previously distributed to the work group). Two of the most significant issues identified thus far in the CALFED public discussion are:

- the need for measures to avoid or mitigate third-party impacts associated with transfers (whether environmental or economic), and
- the relationship between water transfers and local groundwater resources

The physical and regulatory constraints, whether in their existing form or as a result of CALFED Program actions, will continue to provide some level of protection with respect to the ability to transfer water across the Delta. BDAC and the Water Transfer Work Group must consider <u>whether the existing requirements and processes are sufficient to protect source area economies and resources, or whether additional safeguards should be included in the CALFED Program to ensure such protection</u>.

Estimated Available Annual Additional Capacity for Water Transfers at Existing South Delta Facilities Assuming Existing Regulatory Constraints

(result of modelling, conservative operating procedures may further reduce this estimate)



CALFED Bay-Delta Program
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Graph1

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Attachment 1

Use of Economic Risk Model to Investigate Water Transfers

DWR has used the Economic Risk Model as a M&I water management planning tool for feasibility studies and EIR/EIS documentation since 1985. It is currently being used for CALFED project screening and to develop Bulletin 160-98 regional water management plans.

To focus on the effect of water transfers on the reliability benefits of CALFED options or, conversely, the effect of CALFED options on the reliability benefits of transfers (i.e. the demand for transfers), the ERM can be set up to perform the following types of sensitivity analyses:

1. Change in regional M&I benefits of CALFED storage and conveyance options with respect to changes in the costs and availability of transfers.

2. Change in regional M&I benefits of CALFED storage and conveyance options and the quantity of water transferred with respect to changes in water transfer third-party and environmental impact mitigation policies, including mitigation assessments (water surcharges or monetary payments) and restrictions on frequency of transfers and cumulative quantities transferred by region.

3. Change in demand for transfers and quantities transferred with respect to the CALFED storage and conveyance alternative selected.

The ERM uses the concept of least-cost planning to identify the economically optimal mix of Statewide and local urban water management options and exposure to the risk of shortage.

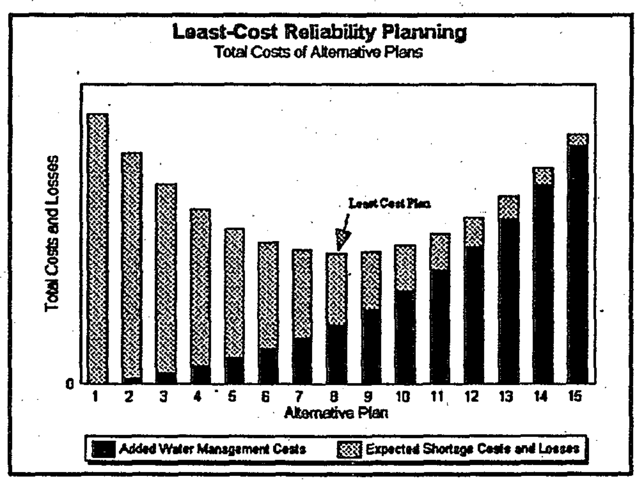

Figure 1 - Identifying an Economically Optimal Plan

Figure 1 depicts a theoretical analysis to identify an economically optimal plan for increasing water service reliability. The top portion of each bar shows the expected shortage losses and costs associated with alternative water management plans. Plan number one represents existing conditions (no additional water management actions.) Plans two through fifteen represent increasing effort to diminish losses and costs associated with shortages through the implementation of additional water management options (both long-term and contingency options, including water transfers). However, associated with these plans are increasing water management expenditures, as illustrated by the lower portion of each bar. The least-cost plan in terms of total costs and losses is plan number eight, where total costs are the lowest. Water management expenditures lower than for plan number eight (plans one through seven) expose the local area to higher shortage-related costs and losses than necessary. Water management expenditures higher than those for plan number eight (plans nine through fifteen) do not "pay for themselves" in terms of additional reductions shortage-related costs and losses.

Figure 2 depicts the primary planning relationships represented in the Economic Risk Model for evaluating, from an economic least-cost perspective, the cost of alternative plans to increase the reliability of a regional water service system. The link between the investment in long-term water management options and the size and frequency of shortages is shown, as is the link between expenditures to make shortage contingency options available as well as the costs and losses associated with those shortages. The ERM uses a yearly time-step hydrologic and shortage impact simulation to best approximate the actual nature of these links. In general, the larger the investment in long-term water management, the less frequent and less severe will be the shortages experienced. Similarly, making shortage contingency options available for future shortage events will lessen the economic, environmental, or social costs of these shortages when they occur.

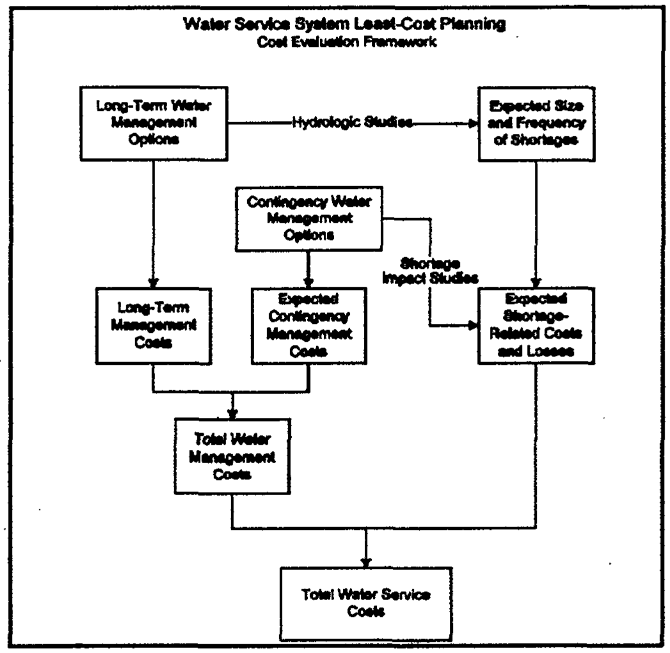

Figure 2: ERM Reliability Modeling Relationships

The capital and operations and maintenance costs of both the long-term and shortage contingency options are included as components of the total water service system costs, the remaining component being the expected costs and losses associated with shortages under those scenarios. Water transfer costs depend upon the quantity transferred during shortages. The price of the transferable water is compared within the simulation to the economic benefit of purchase during each shortage event, thereby affecting the quantity transferred.

Use of different long-term and shortage contingency options affects total water service costs not only directly but also indirectly through their influence on the size and frequency of shortages as well as the costs and losses associated with those shortages. (Because they can also affect costs through their influence on the quality of water provided to users and/or water agency treatment processes, the ERM will be extended to incorporate water quality costs.)

Expected Year 2020 conditions are used to evaluate the potential contribution to regional urban water service reliability of identified water management options for the South Coast and Bay Regions. The option categories capable of being evaluated within the ERM framework from an economic standpoint are:

Fixed Yield Projects and Programs
- Water Reclamation
- Groundwater Recovery
- Conservation Beyond Urban BMP's
- Long-Term Water Transfers
- Ocean Water Desalting

Variable Yield Projects
- Central Valley Reservoirs
- Local Reservoirs

Contingency Yield Programs
- Shortage-Related Water Transfers
  - Colorado River Region
  - Central Valley Regions
- Development of Groundwater Carryover Storage Capacity

The overall conveyance, treatment, and local delivery costs of each option are estimated to the extent possible. When available, data from previously made operations studies are used to measure the yearly contribution of reservoir deliveries to meet both current-year use needs and carryover storage requirements. Shortage-related water transfer options are based on information from pending agreements about total quantities to be made available over the life of the agreement and the yearly quantities that can be made available. In-force agreements on shortage-related water transfers are modeled in the base. Third-party impacts concerns are reflected in assumptions regarding regional restrictions on the frequency of transfers and the total quantity transferred over a specified number of years.

Ideally, because of the hydrologic and operational interdependencies of all the options evaluated, an evaluation of all possible combinations and permutations of the options would be needed to identify a preferred least-cost plan. In lieu of this impractical strategy, the ERM is run for specific reservoir storage supply and Delta conveyance facility scenarios in the context of local water management scenarios which specify three discrete levels of implementation of local water transfer and groundwater carry-over storage options. The economically optimal use of local fixed-yield options and the accompanying exposure to the risk of shortage are then identified for each combination of scenarios.

Appendix

Sources of Model Data: DWRSIM output, local hydrologic modeling studies, water management option cost and availability studies done for Bulletins 160-93 and 160-98, shortage management studies re: 1976-77 and 1987-92 droughts, residential customer water price and contingent value surveys. Specific ERM data needs are as follows:

Hydrologic Parameters

Surface Reservoir Operations
- Available Carryover Storage Capacity
- Carryover Storage Supply Curve

Groundwater Operations
- Available Carryover Storage Capacity
- Recharge Capacity (adjusted for efficiency)
- Extraction Capacity
- Carryover Storage Supply Curve

Conveyance Operations
- Local Aqueduct Capacities
- State and Federal Aqueduct Capacities

Local Water Management Strategies

Carryover Storage Programs
- Use Rules
- Refill Priorities

Shortage Management Programs
- Supply/Storage Status Triggers
  - Contingency Conservation
  - Rationing
- Expected Effects
  - Overall Use Reduction
  - Use Reduction by User Type

Demand Parameters

Average Year Demand
- Current Year Consumptive Use (Includes BMP's)
- Carryover Storage Use
  - In-Lieu Recharge
  - Direct Recharge
- Non-M&I Uses
  - M&I Supplied Agricultural
    - M&I Delivery Dependent
    - Contingency Self-Service Capability
  - Salinity Barrier

Climate-Related Demand Variation
- Current Year Consumptive Use Variance
- Regional Precipitation History (100+ years)

Percentage Distribution of Urban Customers by Type
Core (Industrial)
Semi-Core (Commercial and Governmental)
Non-Core (Residential)

Supply Parameters

Imported and Local Surface Supply
Average Year Deliveries (sources without time series data)
Annual Deliveries from Simulation Studies

Contingency Transfer Supply
Conveyance Facility Constraints
Frequency/Quantity Constraints (third-party considerations)

Amount of Carryover Storage Capacity Filled at Start of Simulation

Operations Cost Parameters

Conveyance

Treatment and Delivery

Ground Water Operations
Recharge
Extraction

Shortage Cost and Loss Parameters

Unit Cost of Transferred Water During Shortages

Contingency Program Implementation Costs
Conservation
Rationing

Residential User Loss Function

Unit Non-M&I Loss
M&I Supplied Agricultural Deliveries
Salinity Barrier Use